This was how the WLW transmitter building looked in 1934. The purpose of the spray pond in the foreground was to cool the water that carried heat away from the transmitter tubes. Note call letters on building front: WLW, WSAI and W8XAL (Author's collection)

Superpower AM Radio in the US: Why it Failed

By John F. Schneider W9FGH

The term "superpower" was bandied about frequently in the early years of American radio broadcasting, but its exact definition was continually evolving. In 1923, superpower referred to the newly-authorized 1,000 watt "Class B" stations. Listeners feared that their powerful signals would wipe out other stations on the dial, which typically operated at from 50 to 500 watts. In 1925, five "Class B" stations were raised to an unheard-of 1,500 watts, but with the proviso that they would have to reduce power if they caused interference. The following June, two stations – WLW and WSAI in Cincinnati – were granted increases to 5,000 watts.

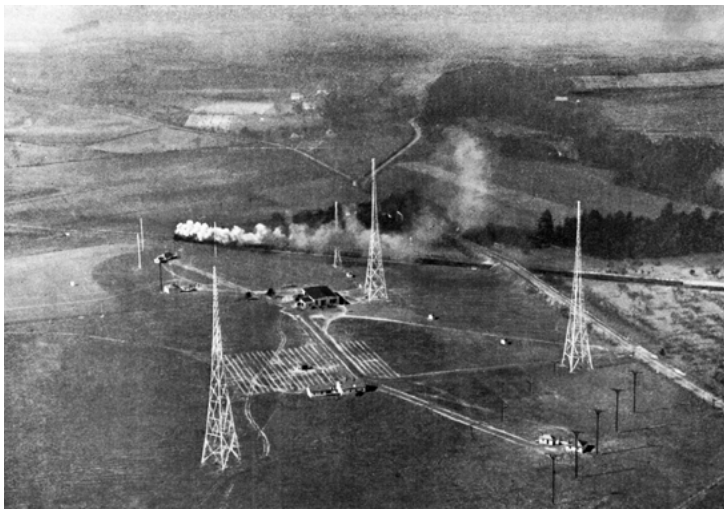
One of the prime developers of radio science at the time was the American industrial giant General Electric. In 1922, the company had opened its own station, WGY in Schenectady, New York, one of the foremost broadcasters in the country. From its 54-acre radio test site in South Schenectady, G.E. undertook a program of research and development for higher power transmitter technology. It was from that site on January 30, 1926, that WGY conducted the first ever test at 50,000 watts. Nearby listeners were afraid to turn on their sets for fear that the powerful signals would blow out their tubes or loudspeakers. *Radio Digest* magazine reported, "It was apparent that the observers had expected to be literally knocked from their chairs by the high power and were somewhat disappointed that something of that sort did not occur." But hundreds of other listeners cooperated in the test program by sending in more than 1,500 signal reports.

Accounts of good reception came in from as far away as the West Coast. The consensus of the test was that WGY's signal strength was nearly doubled while fading and static interference was reduced; yet the tuning of the station was still sharp, causing no more interference to adjacent channels.

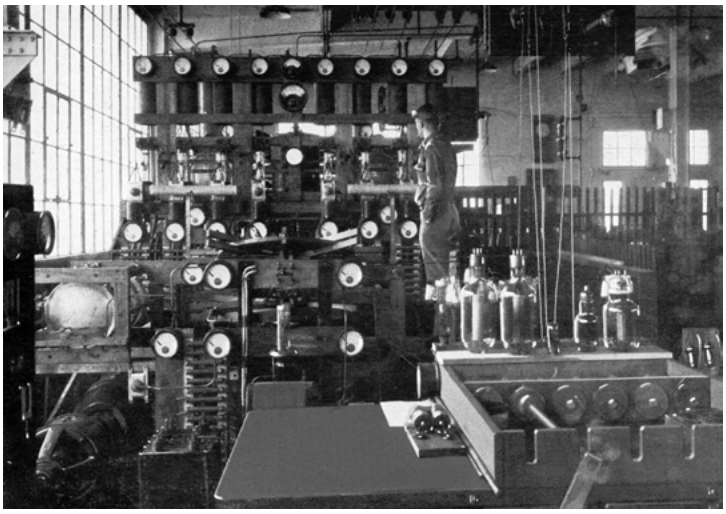
Shortly thereafter, WGY became the first American station to commence regular broadcasting at 50,000 watts. In just six short years, the definition of "superpower" had jumped from 1,000 watts to 50,000 watts, and by 1931, 23 stations operating on clear channel frequencies had been authorized at that power level. But the desire for still more transmitter power didn't end there.

The Never-ending Quest for more Power

In August of 1927, the Federal Radio Commission



The General Electric test facility in South Schenectady, NY. (From the G.E. booklet "Spanning a Continent," 1926)



This is the prototype General Electric 50 kW transmitter which was used in 1926. This was the first American broadcast transmitter to operate with 50,000 watts. (From the G.E. booklet "Spanning a Continent," 1926)

permitted WGY to test a 100,000-watt transmitter during a thirty-day period between the hours of midnight and 1:00 AM using the call sign W2XAG. It employed a new 100 kW GE water-cooled tube, using just two tubes in the RF amplifier and three in the modulator. The test results demonstrated a marked increase in signal strength within a range of 500 to 600 miles - mostly east of the Mississippi and north of North Carolina. A listener in Virginia noted that WGY nicely overrode the noise from a nearby electrical storm. Another, in Minnesota, reported that WGY's volume exceeded that of his local station. Next, in March 1930, WGY conducted another series of tests at 200 kW, transmitting from 4:00 to 6:30 AM over a seven-day period. This time, a flood of reception telegrams arrived from the Pacific Northwest, Alaska and Hawaii.

Not willing to be outdone, the engineers over at Westinghouse in Pittsburgh had developed their own high-powered tube, rated at 200 kW, and the company conducted test transmissions from its own station, KDKA, at a reported 400 kW. These 1931 tests were aired between 1:00 and 6:00 AM from KDKA's 130-acre site in West Saxonburg using the call sign W2XAR.

Meanwhile, at WLW in Cincinnati, talks were taking place about even higher power. Radio manufacturing entrepreneur Powel Crosley, Jr., had progressively increased the power of his station in steps of 10x– from 50 watts to 500 watts in 1923; to 5,000 watts in 1925, and then to 50,000 watts in 1928. He was well aware that a 10x increase in power only produced a 3x increase in signal strength and coverage, and so felt that anything less than a 10x increase didn't justify the investment. And, as one of the country's major manufacturers of radio receivers, he also recognized that most new radios now incorporated an AGC (Automatic Gain Control) circuit, which eliminated any increase in volume the higher power levels would cause. And so, the natural next step for Crosley would be to step up to 500,000 watts – a power level never before attempted. His engineers calculated that such power would give WLW a noise-free signal out to a radius of 250 miles.

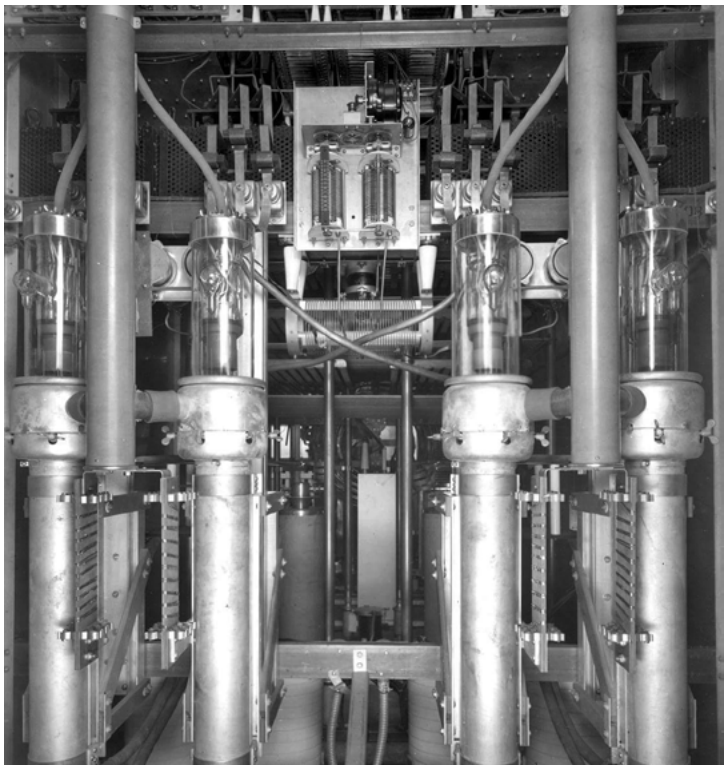
Crosley had lots of friends in high places, and somehow, he was able to coax the FCC to give him experimental authority at 500 kW. It authorized WLW for 50,000 watts of "licensed" power plus another 450,000 watts of "experimental" power under the call sign W8XO.

Discussions began in May of 1932 regarding the construction of the huge transmitter that would be needed. RCA would be the primary contractor, and G.E. and Westinghouse would each build significant parts of the system. By the end of 1932, a final design had been approved and construction on the monstrous new transmitter began the following year. It utilized WLW's existing 50,000-watt Western Electric transmitter as an "exciter" to drive three power amplifiers of 165 kW each. Their outputs were combined in series to feed the new 831-foot diamond-shaped Blaw-Knox tower that was being erected to launch the big signal. There were two modulating amplifiers employing Class "B" high-level modulation to create the audio part of the signal. Between the RF amplifiers and modulators, this immense system needed twenty of the new 100 kW G.E. water-cooled tubes

On May 2, 1934, President Franklin Roosevelt pressed a gold key in Washington that turned on WLW's transmitter for the first time. Although initially operated only after midnight, the experimental authority was soon expanded to encompass the entire day. Field measurements showed, as predicted, that WLW had tripled the size of its coverage area.

Others Clamor to Join the Club

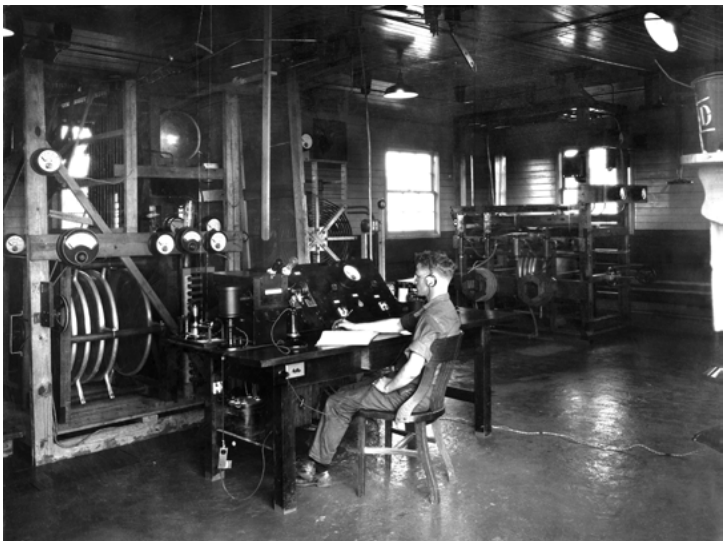
No sooner does one kid on the block get a new toy before everyone else wants one too. Such was the case with superpower AM broadcasting. Other broadcasters noted that WLW was enjoying great success and attracting large audiences and prime advertisers with its new signal. It was effectively operating as a "one-station network" by covering a third of the country with a quality nighttime signal. Several of the country's major broadcasters also wanted in on



Here is another view of General Electric's research laboratory in South Schenectady, New York, dated 1925. The transmitter seen here is operating on 109 meters. (Author's collection)

the action while still others were afraid they could lose their clear channel status if they didn't also seek a power increase (clear channel stations enjoyed the exclusive use of their assigned channels nationwide). In 1935, WGN in Chicago, WSM Nashville, and both KFI and KNX in Los Angeles had filed for either 250 kW or 500 kW. NBC was drawing up plans for a new 500 kW plant for its flagship station, WJZ in New York City. By 1936, a total of fourteen clear channel stations had applied for superpower. This was now creating a problem at the FCC – WLW was operating under a unique experimental authority that needed to be renewed every six months, but for additional clear channel stations to increase their powers, a change in regulations would be required.

While they considered this dilemma, a battle between the "haves" and the "have-nots" was brewing on the sidelines. A number of smaller regional broadcasters that did not enjoy the advantage of wide area coverage began to pressure the FCC to break down the clear channels and permit one or two additional stations to use the same frequency on opposite ends of the country. Of the original forty clear channel frequencies that had first been authorized in 1928, only thirty were still operating as full time exclusive clear channels. The other ten channels were now being shared by two stations, using either time-sharing, frequency synchronization, directional antennas, or the shared use of a single transmitter (in the case of WLS and WENR in Chicago). Combining these two conflicting issues into one case, the FCC established a "Superpower Committee" consisting of Commissioners Craven, Payne and Case. They were assigned the task of reviewing the entire FCC regulation policy for clear channel



This was the transmitting panel of the experimental General Electric 100 kW transmitter used for superpower tests by WGY in Schenectady in 1927. Three of the system's five high power water-cooled tubes are to the left of the operator. (Radio Broadcast magazine, October 1927)

stations. As they first envisioned the case, a realignment of the broadcast band would be needed, with fewer clear channels but allowing for superpower on some of the remaining ones. But the situation would soon prove much more complicated.

For the purpose of influencing the commissioners in favor of their cause, thirteen of the biggest clear channel broadcasters formed a lobbying organization called the Clear Channel Broadcasting Service (CCBS). A staff of lawyers and engineers was assembled in Washington for the purpose of influencing the Commission. But even as these stations were joining forces to lobby the FCC, other broadcast interests were simultaneously aligning to block the adoption of superpower under the banner of an organization, called the "National Association of Regional Broadcast Stations" (NARBS). This second group was principally composed of lower power local and regional stations around the country that did not enjoy the benefits of a clear channel assignment; and even if they did, they lacked access to the ample funds necessary to construct such a superpower station. WLW estimated its 500 kW construction cost at $500,000 - or $9.5 million today - with its electric power and transmitter operating cost being another $66,000 a year, or $1.2 million today. These smaller broadcasters feared losing their audiences and lucrative network affiliations to an exclusive monopoly of superpower clear channel stations. In June of 1936, the Texas Association of Broadcasters was organized, and its first act was to direct a resolution to the FCC opposing the adoption of superpower. The battle lines were now being drawn, and full-scale open class warfare between the broadcasters was about to begin.

The FCC Holds Hearings

The FCC's Superpower Committee held a series of

Radio News magazine, March 1934, tells its readers the story of WLW's new 500 kW station. (Courtesy: AmericanRadioHistory.com)

three hearings in May, September and October of 1936. Dozens of the most powerful and influential broadcaster executives set aside their business and personal plans so they could travel to Washington to testify.

The CCBS group of thirteen clear channel stations first presented its case and declared that there should be NO statutory maximum power limit for AM broadcasting. It argued that clear channel stations provided an essential service to rural listeners, and that the economics of the existing broadcast structure would otherwise result in too many stations serving the large cities while too few attended to the sparsely-populated rural areas. The CCBS projected that a single five-million-watt transmitter would cover the entire country. Powel Crosley, Jr., also testified in favor of superpower and improved service to rural America. He declared that his WLW "endeavored to cover the 'no-man's land' between existing station service areas, to deliver, winter or summer, in spite of atmospheric or other forms of interference, satisfactory reception for the radio listener who cannot afford the more elaborate and costly receiving sets." He noted that WLW's daily mail had quadrupled after the power increase, and that the bulk of its new fan mail came from small towns and rural districts.

For its part, the NARBS, representing 81 member stations in 34 states, testified in opposition to superpower. It projected financial ruin for regional stations, and claimed there was no justification for superpower, either technically, economically or socially. It predicted that the high-power stations would cause international interference, and suggested that, if approved, such stations should be located in localities where they would render unique services that could not be duplicated by any other means.

CBS Chairman William S. Paley testified in opposition, observing that superpower would make "the big fellow stronger and the little fellow weaker." He also pointed to the forthcoming introduction of television and expressed concern about the cost of building high power AM and television facilities at the same time. Nonetheless, although he was generally opposed to the concept, he declared that, if it were approved, CBS would apply for its full quota of superpower outlets.

Former Federal Radio Commissioner Harold LaFount laid out a strong argument against superpower. He declared that "Half of the non-network stations in the country are not showing a profit. All the major stations are affiliated with the networks, providing duplication of programming which is now adequately provided by the chains of existing stations. If the networks affiliate with superpower stations, they would be likely to drop their regional affiliates, leaving these stations to provide for themselves." LaFount also observed that there were "374 full time stations having an aggregate nighttime power of 2,188,650 watts. Of these, 2,000,000 watts were allocated to network affiliate stations on clear channels. …. 97% of the total power is used by 165 full time network affiliated stations, leaving just 58,350 watts for the 209 independent full time stations."

Dr. Greenleaf Pickard, a respected Boston radio engineer, expressed his concern about international interference, especially in the Western Hemisphere. He also pointed out that stations could increase coverage without raising power by adopting more efficient antenna designs, such as the full wave Franklin antenna.

Faced with this unexpected opposition to superpower, the FCC commissioners chose to punt – they delayed their decision and declared that more studies and tests were needed.

WLW's Superpower Authorization is Rescinded

For over three years, WLW had enjoyed its nationwide

superpower exclusivity, operating under temporary experimental authorizations that needed to be renewed every six months. On December 1, 1937, it submitted another one of these routine applications. But to their shock, instead of receiving another rubber stamp approval, the application was designated for hearing by Commissioner George H. Payne, a member of the Superpower Committee.

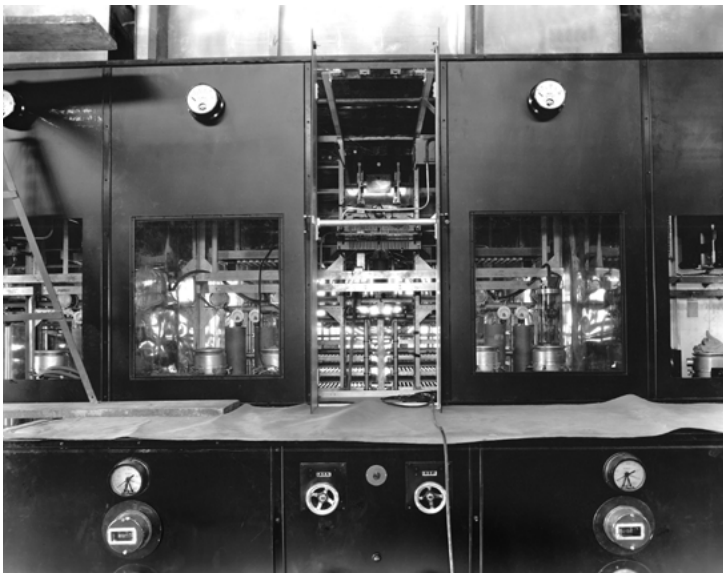
Hearings on the WLW renewal began at the FCC in July of 1938. Powel Crosley marshaled a team of lawyers and engineers to make his case before the commissioners. It was a contentious, hard fought battle, but in the end the three-commissioner panel voted unanimously to not renew. Crosley appealed the decision to the courts, but his appeal was also denied.

WLW's 24-hour superpower authority terminated in 1938, and the station returned to 50 kW on March 1, 1939, although it retained its original experimental authority to broadcast after midnight as W8XO. Despite this setback, the huge transmitter did not go silent forever. It's rumored that the big rig, which could be easily heard in Europe, was pressed into service on several occasions during World War II to broadcast clandestine messages to agents behind enemy lines.

After the defeat of his superpower case, Powel Crosley seemed to have lost interest in radio broadcasting, and he turned his personal attention to developing other consumer products, including automobiles and refrigerators. But he continued to own WLW until he died in 1961. Crosley Broadcasting was sold to AVCO Electronics in 1975.

Broadcasters take aim at Congress

By 1937, frustrated by the FCC's intransigence, the clear channel broadcasters began airing announcements encouraging their listeners to write their congressmen to support high-powered broadcasting. Not to be outdone, the regional broadcasters also began lobbying their local congressmen, most of whom highly valued the support of their local radio stations to publicize their Washington activities and re-election campaigns. Accordingly, the battleground moved from the FCC to Congress. At this same time, the Senate was debating its approval of the "Havana Treaty" – also known as the "North American Regional Broadcasting Agreement" or NARBA. This was a 1937 agreement between the United States, Canada, Mexico, Cuba, the Dominican Republic and Haiti to realign the AM broadcast band and reapportion its channels among the countries. However, the agreement could not take effect until ratified by the Senate, and Montana Senator Burton K. Wheeler announced he would oppose the treaty unless the Senate also passed his Senate Resolution 294, now known as the "Wheeler Resolution," establishing a maximum AM broadcast power of 50,000 watts. On June 13, 1938, the Senate adopted its "Sense of the Senate" resolution stating that the FCC should not allow any stations to operate at powers greater than 50,000 watts. Superpower, it declared, "would tend to concentrate political, social and economic power and influence in the hands of a very small group … and … would have adverse and injurious economic effects on other stations operating with less power."

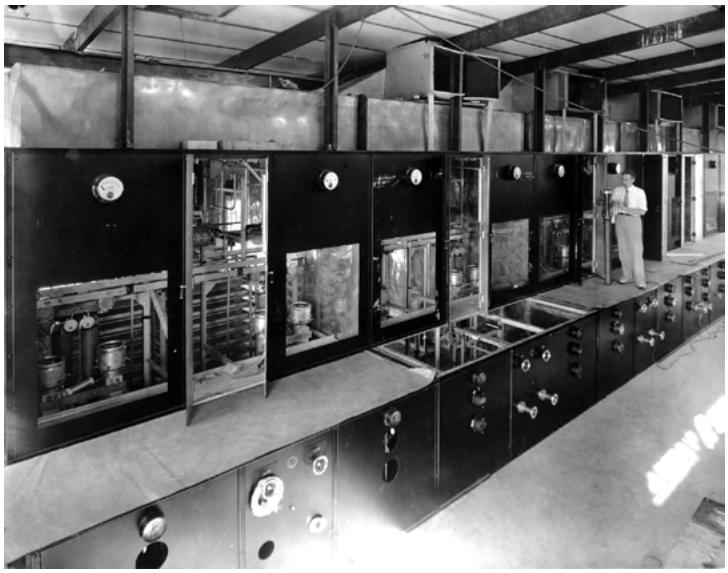


This is a view of a portion of the WLW 500 kW transmitter during its assembly in Cincinnati. The giant transmitter operated from 1934 to 1939 and is still in place in the WLW transmitter building to this day. (Author's collection)

Taking its cue from the Senate, the FCC implemented a 50,000-watt cap on all AM broadcasting the following year. It seemed that the issue was now finally settled, but in fact the battle for superpower was far from over ….

The Clear Channel Debate goes On… and On…

Although the FCC had now declared an upper power limit, it was still uncertain about how to organize and manage the clear channel frequencies. Should clear channel stations continue to enjoy their nationwide exclusive use of their frequencies, or should the channels be broken down to allow additional stations to occupy them in disparate parts of the country? Hearings and studies on the topic began in 1939 and, except for a temporary hiatus during World War II, dragged on continuously until 1948. The focus was now on opening up opportunities for other stations to use the channels, creating more regional stations instead of covering vast areas with high power signals. But the clear channel stations, as represented by the CCBS, had not thrown in the towel on superpower, and in 1948 they submitted a plan calling for twenty stations to operate at 750 kW. Even though the FCC was now unlikely to adopt such a plan, their strategy appeared to be to keep the superpower issue in play. As long as there was the possibility of high-powered authorizations, the channels would not be broken up. This debate was further complicated by the expiration of the NARBA treaty in 1949. The renewal negotiations that followed were contentious – Cuba, Mexico and other countries wanted to establish their own operations on the U.S. clear channels. These negotiations dragged on for years, effectively stalling any further progress on the clear channel issue. Congress did not finally



Another view of the WLW transmitter during its installation. (Author's collection)

approve the new NARBA treaty until 1960.

Ultimately, in 1961, the FCC's Docket 6740 finalized the breakup of the clear channels and codified in its regulations a definite 50 kW power limit. Gradually, new "Class I-B" or "Class II" stations were assigned to the clear channel frequencies, sharing the channels with the legacy "Class I-A" stations. The CCBS appealed the ruling to Congress, and continued to press for its 750 kW assignments, but their further lobbying efforts now fell on deaf ears. The organization finally closed its Washington office in 1968.

Aspidistra

There is one fascinating postscript to the superpower story, and it involves the British black propaganda station "Aspidistra." In 1938, RCA was so convinced the FCC would authorize 500 kW for its New York City flagship station that it decided to get a head start on the project and begin construction. It began the assembly of a second 500 kW transmitter, based on the WLW design but incorporating numerous improvements. Similar to WLW, it incorporated a 50 kW "exciter" followed by high-level Class "B" amplifier and modulator stages employing 26 high power tubes. But then, when Congress intervened to stop the FCC proceedings, RCA found itself with a white elephant on its hands.

When World War II began in Europe there were suddenly new urgent requirements for high-powered transmitters. In 1942, the British Secret Service purchased the WJZ transmitter for £165,000. RCA's engineers modified it to produce 600 kW of power and to allow for quick frequency changes, and the entire system, including antenna towers, was shipped to Britain. A ship carrying the 50-kW exciter and one of the three towers was sunk by a German U-Boat, and so replacements then had to be sent. Finally, the completed transmitter was installed in an underground bunker at Crowborough in Southeast England, and the station, codenamed "Aspidistra," went on the air November 8, 1942.

A quintet of famous radio actresses and singers pose on the mezzanine level of the WLW 500 kW transmitter, holding a few of the twenty UV-862 water-cooled tubes that powered the transmitter. Shown here are (L-R) Margaret Carlisle, Mary Alcott, Ethel and Dorothea Ponce, and Flo Golden. (Author's collection)

Aspidistra's sole purpose was to transmit fake programs to confuse the enemy. It laid down such a powerful signal over Germany that it was easily believed to be a local station. When Allied bombing raids took place over German Cities, the Reich's local stations would be turned off so that the enemy planes couldn't "home in" on their signals. But at the exact moment the German stations left the air, Aspidistra would begin its transmissions on the same frequency, impersonating the local stations with German announcers and giving false and demoralizing information to the German audiences. For example, it announced that counterfeit currency was being circulated, and that evacuation orders were given for areas not being bombed. The frustrated German authorities responded by announcing "The enemy is broadcasting counterfeit instructions on our frequencies. Do not be misled by them. Here is an official announcement of the Reich authority." But then Aspidistra would broadcast the same message, further confusing German listeners.

After the war ended, the Aspidistra site became a conventional BBC medium wave station. The original WJZ transmitter continued in use until it was finally retired by the BBC in 1962.

Today, 50-kW is Just Flea Power

Even today, 50,000 watts remains the ceiling power level for AM broadcasting in the United States. However, superpower AM broadcasting has existed for decades in many parts of the world. There are numerous such stations in our own hemisphere, including Trans World Radio in Bonaire (440 kW), and XEW in Mexico City and Radio Globo in São Paulo, Brazil (250 kW each). But even those power levels pale by comparison to what exists in other parts of the world. There are now more than thirty medium wave broadcasters

around the world operating with at least a million watts. In Hungary, Antenna Hungária operates on 540 kHz with 2 million watts with an all-solid-state system built by the Canadian manufacturer Nautel, Ltd. Saudi Arabia is said to operate three stations at two megawatts each, and Viet Nam has one such station. For many decades, the Voice of America has operated superpower medium wave transmitters in different parts of the world. In the 1970s, the VOA transmitted into China from Okinawa with one million watts on 1174 kHz, and it still operates at this power level today on 1575 kHz from Thailand and on 1170 kHz in the Philippines.

As the AM band declines in popularity and importance around the world, a number of high-powered stations have been shut down due to their high operating costs. European government stations have especially become victims to these budget cuts. However, there are numerous Christian stations that continue to blast out powerful signals, such as Trans World Radio in Monte Carlo. The mammoth installations of these superpower stations undoubtedly represent the pinnacle of high-power radio engineering. When the last one disappears, the world may never see their kind again.

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TSM